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Winds of Change: Is the Global Gas Business Experiencing Transformation?

New technology and markets are driving the transformation of global gas, with LNG in the lead. The business has to cope with changing seasonality, the role of traders, more non-traditional buyers, the appearance of unconventional gas on world markets, and shifting pricing methods. While pricing and the supply-demand balance look more favourable for exporters, they still have to look to the longer term. Deploying technology effectively, creating markets, building gas's image and forging partnerships are key to assuring gas's future.

Sakhalin-2 LNG: Shell

Executive Summary

- The **global gas market is transforming** due to the rise of unconventional gas, demand growth in emerging Asia, and widespread adoption of floating LNG regasification.
- The technological transformation is catalysing the emergence of **new markets and new business models.**
- To the early 2020s, concerns about an LNG glut have been replaced with **growing views of a tight market.**
- **New LNG markets are emerging**, both geographically and in sectors, but supplying them effectively requires more active approaches.

Implications for Middle East Oil Producers

- In the short-term, gas exporters can **take advantage of strong demand and pricing,** while avoiding a price spike.
- In the longer term, they need to **support new technology and gas-friendly policies**, including carbon capture, hydrogen, and air quality regulations.
- Leading gas exporters need to show **increasing flexibility in price and contract terms** to ensure growing demand in the face of competing energy sources.
- New markets require **tailored approaches** and a more active effort to develop demand through infrastructure and institutions.
- The size and complexity of the new global gas business makes it essential to **build strategic alliances** along the value chain, including Chinese majors, global traders, utilities and technology providers.

New technologies are swinging the supply and use of gas

Two dates are key for the modern gas business. In 1997, Mitchell Energy carried out the first successful massive hydraulic frac in the Barnett Shale, which opened the way for the unconventional gas boom. And in 2005, the world's first LNG floating storage and regasification unit (FSRU) started operations, the US's Gulf Gateway.

Shale gas brought down North American gas prices sharply and changed the industry mentality from one of shortage to abundance. Now the US is set to be one of the world's three largest LNG exporters by 2025, and is estimated to have enough resources to meet 25 or more years of (greatly expanded) demand at a price no more than $2.8 per MMBtu[1]. Unconventional gas production is spreading into other countries, including China, Australia, Argentina, Saudi Arabia and Oman.

Conventional gas resources have also expanded due to major discoveries in new plays, including Mozambique and Tanzania, Mauritania/Senegal, the Kurdistan region of Iraq, the Brazilian pre-salt, and the deepwater East Mediterranean.

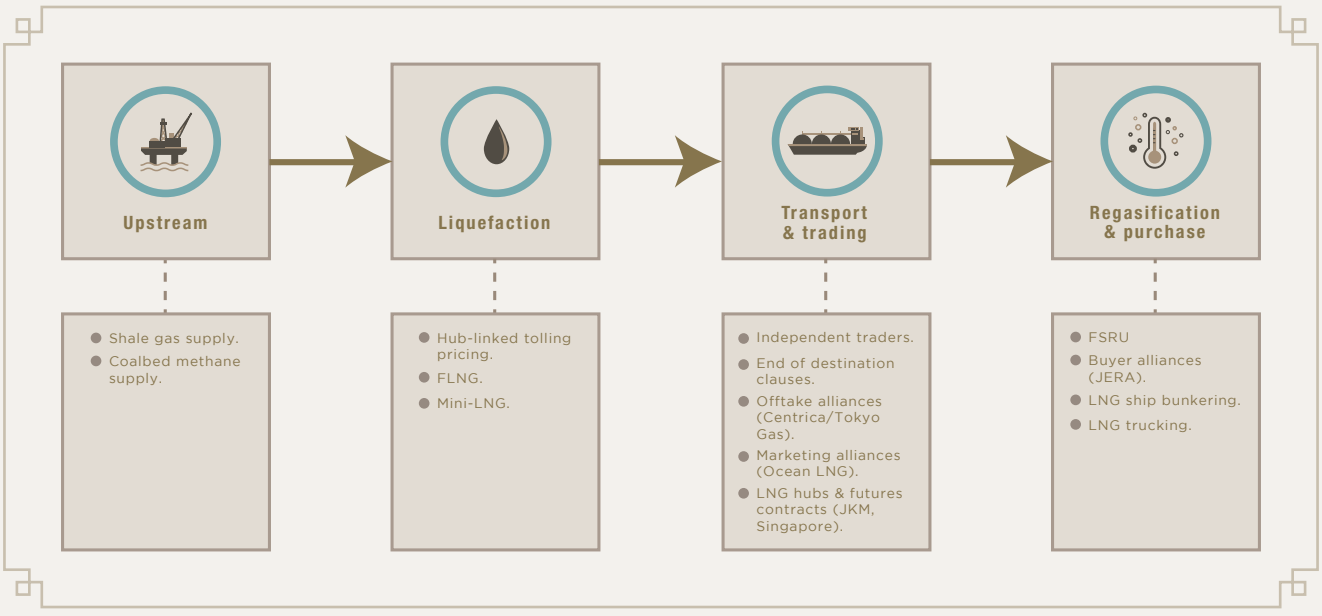
FSRUs are quick to install (12-18 months) and have lower capital costs and land requirements than traditional onshore regasification facilities. Their use has opened up new markets, particularly smaller or less credit-worthy ones, or those that require LNG only on a seasonal basis.

Floating liquefaction plants[2] are also emerging as a potentially important technology, with facilities in Malaysia, Australia and West Africa starting up. With development, they can access smaller or remote resources, potentially at a lower capital cost and time than onshore facilities, helping to support and diversify global LNG supply.

These new technologies have catalysed the emergence of new business models

Alongside these new technologies, novel business models are emerging (FIGURE 1).

FIGURE 01: **NEW BUSINESS MODELS**



Although pipeline gas too has expanded, LNG has been taking a steadily larger share of world trade. Major new international pipeline projects have proved difficult to progress in face of political obstacles.

Russia's Nord Stream II and Turkish Stream pipelines are largely replacing existing routes rather than bringing new capacity. The growth in exports from the US to Mexico and the development of routes from Iran to Iraq, Israel to Jordan and Egypt, Turkmenistan to China, and from Azerbaijan through Turkey to Greece and Italy, are important. The most significant international pipeline project, Russia's Power of Siberia line, is another key part of the gasification of China.

With these exceptions, though, the integrated international gas networks of North America and Europe have not been replicated elsewhere. South-east Asia, the 'Southern Cone' of Latin America, the Middle East, and the emerging African gas markets, consist of independent gas markets served by LNG and domestic gas, with only limited pipeline interconnectivity.

LNG traders have become increasingly important. They are more willing to absorb the risk of non-traditional buyers or to balance it against their deliveries of other commodities; they aggregate demand to boost bargaining power; and they can play different pricing mechanisms using their exposure to the underlying commodity (crude oil or Henry Hub gas). Such participants include the trading arms of majors such as Shell and BP; pure LNG producers such as Cheniere and Tellurian; dedicated trading companies including Vitol, Trafigura, Glencore and BB Energy; and oil majors without LNG upstream of their own, such as Rosneft.

However, if LNG shifts into shortage, traders face the challenge of sourcing cargoes in what is still a relatively illiquid market. Margins are thin, and shipping costs and boil-off losses limit arbitrage and make it impractical to store LNG at sea for long periods.

LNG market perceptions have swung from a glut to concerns of a future shortage

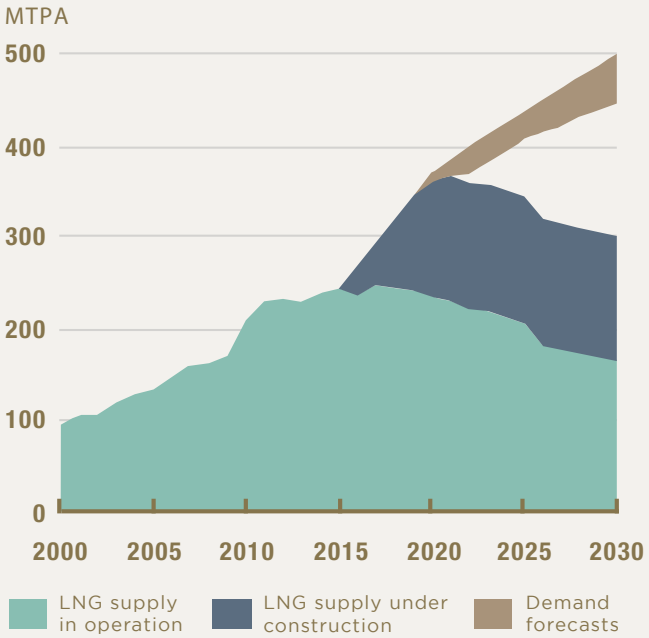
The rapid expansion of output from projects in Australasia and the US in particular created concerns of an LNG glut stretching out into the early 2020s. Customers in China and India were able to renegotiate their purchases on advantageous terms. Partly because of a well-supplied market, but also because of structural changes, contract terms and volumes have become shorter.

Buyers both of pipeline gas and LNG have sought greater flexibility. This has particularly been seen in the EU's decision to end Gazprom's 'destination clauses', which forbade resale outside designated markets. Japanese authorities have also ruled against the clauses[3] and Tokyo Gas will not accept them in new LNG contracts[4]. The EU is now looking at destination clauses in Qatar's LNG contracts, having earlier challenged them for Nigeria and Algeria[5].

30 million tonnes of new liquefaction capacity entered the market in 2017, with another 40 million tonnes per annum (Mtpa) forecast for 2018. Yet fears of oversupply have been eased by unexpectedly strong growth in demand in China in particular (+12.45 Mtpa), and in some newly-emerging markets such as the Middle East, India and Pakistan. China could grow even further as it solves transmission bottlenecks.

A dearth of new final investment decisions (FIDs) left supply in the 2020s seeming short (FIGURE 2). New projects are available in East Africa, Western Canada and north-west Africa, but are immature or have been held up by a mix of high costs, government incapacity and local opposition.

FIGURE 02: **LNG SUPPLY-DEMAND BALANCE[6]**



Qatar has moved to fill this gap by announcing an expansion of its world-leading LNG business from 77.5 to 100 Mtpa by the end of 2023. Its existing infrastructure and giant scale ensure that it will be the world's most cost-competitive. The US will be the other key contributor, though not all announced projects will go ahead. Russia's Arctic-2 LNG will build on the success of its Yamal project, but it will mostly continue to focus on pipeline exports. Sanctions and domestic debates will prevent Iran from capitalising on its large, low-cost reserves.

With Chinese gas demand set to gear up further, and the window closing for new LNG plants to hit the market before 2022 or 2023, the market opportunity is clear. The major risk to such a promising outlook is economic growth: a significant recession, perhaps in combination with a 'trade war' or geopolitical crisis, could cut demand.

New markets are emerging – but some need a helping hand

The development of new geographic markets for gas has been driven by three factors. Firstly, new gas finds have created local demand, as in Israel and Tanzania. Secondly, growing economies, particularly in Asia and the Middle East, and more

recently parts of Africa, have sought gas as a relatively clean energy source, and cheaper than oil. Thirdly, FSRUs have reduced the barrier to entry for LNG imports.

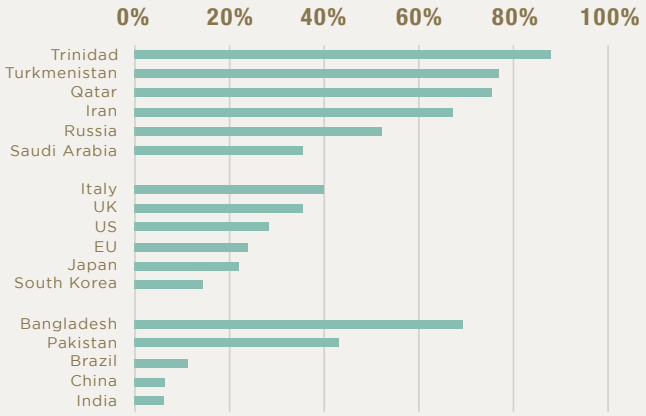
Gas's share in primary energy varies enormously by country (FIGURE 3). Three groups of countries are shown. The first are major gas producers where gas is a leading source of energy, to the extreme case of 87.8% in Trinidad.

The second group, of developed countries, have more balanced energy mixes. The share here varies from Italy's 39.7%, even though it is not a major producer itself, to South Korea's 14.3%.

The third group, of developing countries, includes some with high shares of gas, and some large countries with very low use. Many countries, particularly in Africa, currently have no access to gas at all. Yet because of its huge economy, China, where gas is just 6.6% of primary energy, consumes 240 BCM per year, behind only the US and Russia.

From the point of view of future demand, it is obviously in the interest of major gas exporters that China and India evolve more towards Italy than South Korea. Even if China's share of gas 'only' reaches South Korea's level, this would still be double its current proportion. BP expects China's primary energy demand to grow by 40% from 2016 to 2040, and its gas consumption to grow from 220 to 647 BCM per year, 13% of primary energy. If it instead reached Japan's level of 22.1%, that would be 1110 BCM per year, an enormous market opportunity, more than the current total consumption of Europe plus the Middle East.

FIGURE 03: **GAS SHARE IN PRIMARY ENERGY, SELECTED COUNTRIES (2017)**[7]

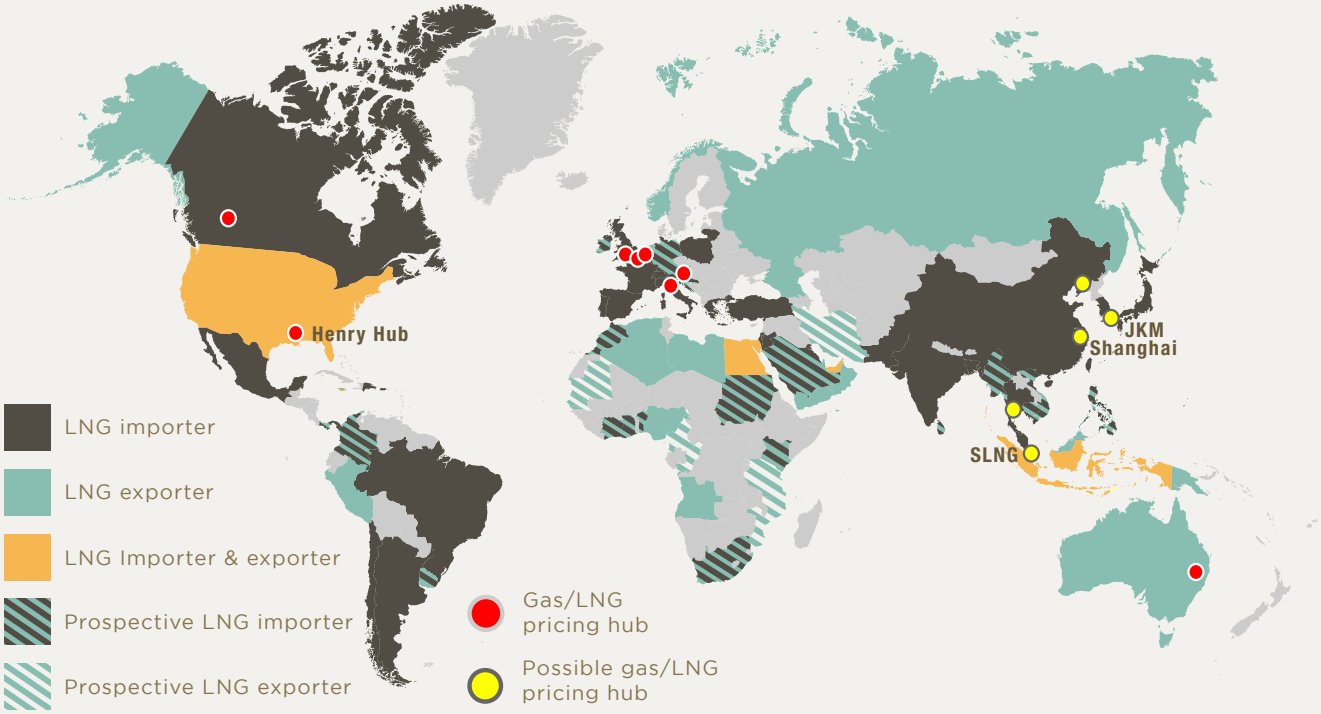


Emerging LNG importers include those that are less creditworthy than traditional buyers in Europe, Japan and South Korea: these include Pakistan, Bangladesh, Jordan, Egypt and several prospective Sub-Saharan African importers such as Kenya, Ghana and Benin.

New importers' seasonality may also be different. Middle Eastern countries, including the UAE, Kuwait and later Bahrain, have peak demand in the summer, contrasting with markets requiring heating in the Northern Hemisphere winter – NW Europe and NE Asia. This creates opportunity for complementary deals.

FIGURE 4 shows the emergence of these new suppliers and consumers. Almost every coastal country in the world now

FIGURE 04: **NEW LNG MARKETS AND PRICING HUBS**



exports LNG or is importing or planning to import it, or at least will have access to LNG from a neighbouring country.

The outlook for traditional markets is less promising. Japan is likely to decline from 84 Mtpa in 2017 to 62 Mtpa in 2030, as its nuclear plants restart, and also due to slow economic growth, population shrinkage and increased use of renewables[8]. South Korea's is expected to grow gradually as it cuts reliance on coal and nuclear, gaining about 4 Mtpa by 2031[9].

Europe has an objective to diversify from Russian gas, but this will not happen by magic, as long as Gazprom protects its market share by pricing competitively. The complete shut-down of the Netherlands' giant Groningen field by 2030, due to earthquakes, declines in other indigenous production, and the phase-out of coal, will encourage imports. But energy efficiency measures and the growth of renewables will eventually hit gas demand; BP sees EU gas demand essentially flat from 2016 to 2040.

Gas needs to remain price-competitive

Traditional oil-linkage of gas prices has come under pressure. In Europe, Gazprom has been compelled to accept increasing shares of indexation to traded hubs (such as UK NBP, Belgium's Zeebrugge, Italy's PSV and TTF in the Netherlands), to ensure it remains competitive. US LNG producers have introduced a new formula based on the cost of Henry Hub (upstream gas) plus the capital and operating costs of liquefaction. Singapore has launched an LNG futures contract, while Vitol, Trafigura and Pavilion Gas were recently approved to participate in Platts' transparent LNG pricing process[10].

China, which has the combination of pipeline gas imports (Russia, Turkmenistan and Myanmar), domestic gas production and LNG imports, appears a natural site for a gas pricing hub. The Chinese desire to play a role in setting the price of their commodity purchases is indicated by the launch of their Shanghai oil futures contract in March 2018. These existing and prospective hubs are shown on FIGURE 4.

Meanwhile, gas prices in the Middle East remain largely set by governments, typically well-below international levels, but the spread of LNG imports and shortages of legacy low-cost domestic gas have led countries such as Egypt, Oman and Bahrain to raise gas prices steadily. Egypt is now in the process of liberalising its gas market entirely, and others may follow.

Price-competitiveness and market responsiveness are essential. Gas has four primary markets – power generation, industry, petrochemical feedstock, and residential/commercial - and one potential growth market, transport. In each of these, it faces competitors with different characteristics.

In the **power sector**, gas can be squeezed between a cheap, dirty, legacy fuel – coal – and increasingly cost-competitive, near-zero carbon renewables (mostly wind and solar). Though currently nuclear is expensive and inflexible, new technologies might allow it to play a larger role.

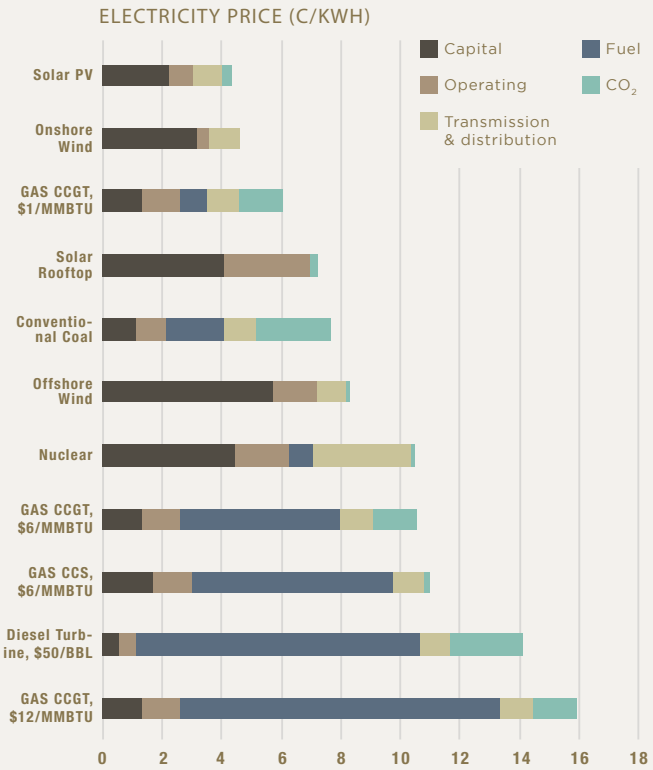
Gas enjoys some price premium, but has to be cheap enough to displace coal. It has achieved this in the US and UK, and could in continental Europe. To crack the next big growth markets, China and India, it needs to remain very cost-competitive.

In sunny locations such as the Middle East, parts of Latin America, Africa and India, Australia and the south-west US, solar photovoltaic (PV) power is already cheap enough to beat the fuel price of gas, and the same is true of onshore wind in good areas such as the US Mid-West (FIGURE 5).

The recent bid of 7.4 c/kWh for concentrated solar power with storage in Dubai is a significant threat to gas demand, since it allows even night-time demand to be met by solar.

Gas is highly complementary to renewables, being flexible and able to ramp up and down to meet fluctuations of demand and weather, as well as to meet seasonally high demand when renewables are insufficient, as in cold, windless European winter evenings. However, short-term balancing on a scale of hours or overnight will increasingly be performed by batteries. Utilisation rates of gas power plants will drop. Higher rates for capacity or peak power can keep them profitable, but their gas consumption will drop.

FIGURE 05: **POWER GENERATION COST BY TECHNOLOGY[11]**



Some promising carbon capture and storage (CCS) technologies are being introduced, which would eliminate most of gas's carbon footprint. But these have to be supported by government policies – such as carbon prices or CO_2 emission standards – and will still have to compete

economically with low-carbon alternatives. Carbon dioxide injection can also free up large quantities of natural gas currently used for enhanced oil recovery in countries such as the UAE and Iran.

In **industry** and **residential/commercial**, gas remains very attractive, for providing clean, convenient and inexpensive heat for industrial processes, space and water heating, and cooking. These are often hard to replace with renewable energy, because of seasonality and the requirement to meet demand surges.

However, renewables with battery storage, renewable heat (solar and heat pumps), and improved efficiency (such as smart buildings, district heating/cooling, and Germany's 'Passivhaus' programme) will reduce the residential and commercial market in Europe and perhaps North America. In the longer term, a clean fuel, hydrogen, made either from natural gas or the electrolysis of water (using renewable or nuclear power) could be introduced to the gas grid.

For **petrochemicals**, the methane and ethane components of natural gas are essential for the production of fertilisers, methanol, ethylene and other products. However, major oil exporters see the petrochemical market as a key growth area for them too, with Saudi Arabia and the UAE investing at home and abroad in mixed-feed crackers (using both ethane and naphtha) and 'crude-to-chemicals' complexes.

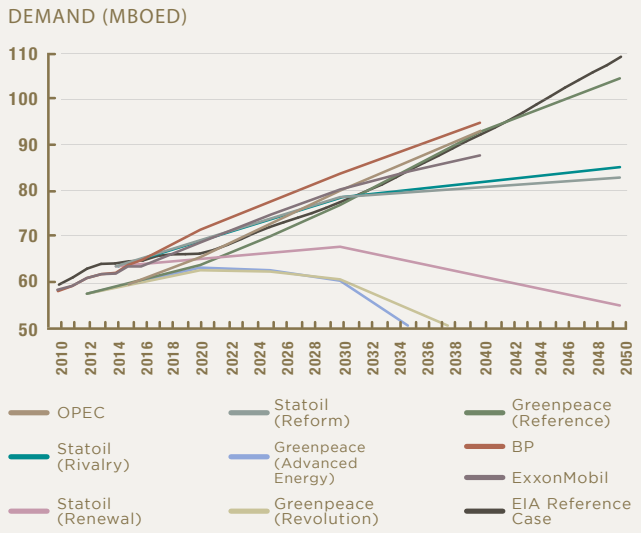
In transport, natural gas (as LNG) may find a role in long-distance trains and trucking, though this has been slower to take off than advocates have expected. Compressed natural gas (CNG) for passenger vehicles and buses has been adopted to improve urban air quality, but is likely to lose ground to rapidly-improving electric vehicles. The best bet for gas demand growth in transport is shipping, where the IMO 2020 regulation restricting the sulphur content of bunker fuel[12], and expected further action to reduce CO_2 emissions, makes LNG increasingly attractive.

BP sees that gas in transport could rise from 52 BCM in 2015 (mostly gas used in pipeline compressors, plus some CNG vehicles) to 179 BCM in 2040, though this would still only be 4.8% of total transport energy demand. Raising it further would demand aggressive action by gas-exporting countries and companies to promote LNG, create LNG storage and bunkering infrastructure at key global nodes, and convert their own shipping fleets.

Given its lower energy density, LNG is less convenient than oil-based fuels, and leaves less cargo space. Therefore, it will have to be priced competitively against the alternatives (diesel for trucks; and marine diesel, low-sulphur fuel oil, or high-sulphur fuel oil plus a scrubber, for ships).

The long-term view on gas demand from major forecasters is quite rosy (FIGURE 6), seeing strong growth. However, aggressive movement on climate change (Greenpeace, Statoil's 'Renewal' scenario or the IEA's '450'), without CCS for gas, could lead to a drop in gas demand as early as the 2030s.

FIGURE 06: **LONG-TERM GAS DEMAND FORECASTS**[13]



Alliances

Alliances are vital to navigate the new gas world.

- **Buyer-buyer:** Tokyo Electric + Chubu Electric formed JERA.

  JERA signed MoU on cooperation with CNOOC, KOGAS.

  Centrica + Tokyo Gas signed combined purchase agreement for Mozambique LNG.

- **Buyer-trader:** JERA and EDF combined their trading arms.

- **NOC-IOC:** Qatargas + ExxonMobil launched Ocean LNG to market LNG produced outside Qatar.

  Shell + Qatar Petroleum formed LNG bunkering JV.

Future radical shifts can be expected

The gas business is capable of further innovation in technology and business models. While wild-cards are always likely, four bold predictions can be advanced.

- China's growing gas demand will make it essential for the country to master technology and markets. It will have to develop or buy its own liquefaction technology, develop LNG plants as lead operator, and become a leading LNG trader. It may buy a leading gas turbine business. It will persist with its domestic unconventional gas development.

- Unconventional gas production will go global, at least in countries with supportive geology and regulation. Beyond shale, resources such as hydrates may be commercialised by energy-poor states such as Japan.

- Efficient and cost-effective gas CCS technologies are emerging for power and industry. Their large-scale

deployment, though, will depend on climate policies, electricity markets, and competition from concurrent advances in energy storage and nuclear power.

- Liquefied natural gas and/or hydrogen will emerge as a preferred fuel for shipping, and hydrogen may be used as an energy storage medium, in aviation and in heating. Japan has shown particular interest in hydrogen.

Each of these presents an opportunity for leading gas exporters to partner and to invest in deploying new systems. Russia is already working closely with China in gas, but the two Eurasian giants have some political suspicions. That gives an opportunity for another gas player to forge a close working relationship with one or more of the leading Chinese energy majors.

Conclusions: Implications for leading gas exporters

Major gas exporters face challenges on the short and the long term. In solving the short-term, they have to be careful to support their long-term goals also.

In the short/medium-term, over the next five years or so, gas exporters need to manage the three key dimensions of the changing market:

- **Contract terms** – adapt to shifting pricing bases, with more use of hubs and a reduced role of oil-price linkage; and shorter, more flexible terms. Contend with impending contract expiries as bargaining power swings back towards sellers.

- **New markets** – deal with the greater variety of buyers, including traders, less creditworthy and smaller markets, and non-utility buyers such as shipping. Exporters can take a greater trading role themselves, either alone or with a strategic partner, such as Qatargas's tie-up with ExxonMobil to form Ocean LNG. Even if trading margins are not large, they need to retain a close link and understanding to their customers, and not give it up to intermediaries. They can formulate novel offerings for new importers and non-traditional customers, including more lenient payment terms, infrastructure financing, and packages with other services.

- **Cyclicity** – capture the expected upturn in prices and demand, maximising revenues while avoiding another damaging spike in LNG prices. This includes promptly committing to new production and pipeline and LNG export capacity and investing in new gas production and export projects outside their home country to help bring new resources to market as well as diversifying a trading portfolio.

In the longer term, to 2040 and beyond, the nature of the challenges shifts. The primary task of major gas exporters is to maintain robust demand for their product. Components of this include:

- Ensure that gas retains its advantage as '**Abundant, Affordable and Acceptable'**. Use public relations, media, and relationships with thought leaders, major consumers, their governments and environmental groups to emphasise gas's environmental advantages. Push for policies, such as carbon pricing and air quality standards, that would favour gas over coal. Encourage the deployment of gas-based carbon capture and storage systems, and hydrogen. Avoid the temptation to use gas as a geopolitical tool.

- Support the **development and expansion of gas markets, gas-consuming industry and infrastructure** in the major areas of potential gas demand growth, particularly China, south-east Asia, the Indian subcontinent and Africa. This includes growing non-traditional uses, particularly LNG ship bunkering and trucking. It can also include investing in consumer energy/electricity distributors, and in utilities and gas-consuming industries. Smaller African markets may not support an LNG terminal for every country, while landlocked states are inaccessible, so hub-and-spoke designs with gas pipelines, LNG delivery by truck and electricity interconnections are essential.

- **Create and expand liquid markets,** with transparent pricing. This may not be supported initially, and would result in gas exporters losing some market power and potential margins and arbitrage opportunities. But in the longer term, it is essential to the task of moving gas from a niche fuel in top emerging economies, to a core source of energy.

- **Build strong partnerships** with related energy companies and consumers. Key targets for partners include one or more major international oil and gas companies; top global energy traders (Vitol, Glencore, Trafigura, and others); at least one of the Chinese oil majors (CNPC, Sinopec and CNOOC); large utilities and industries in China, India and other leading emerging markets; and providers of leading-edge technology in LNG, marine fuels, gas turbines, carbon capture and hydrogen.

AGA Nynäshamn LNG marine terminal

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